DOCUMENT RESUME

ED 432 222 IR 019 592

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TITLE	Teacher Technology Competencies: Early Indicators and Benchmarks.
PUB DATE	1999-03-00
NOTE	7p.; In: SITE 99: Society for Information Technology & Teacher Education International Conference (10th, San Antonio, TX, February 28-March 4, 1999); see IR 019 584.
PUB TYPE	Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Accountability; Benchmarking; Classification; Comparative Analysis; *Competency Based Teacher Education; *Computer Uses in Education; Curriculum Development; *Educational Technology; Educational Trends; Elementary Secondary Education; Faculty Development; Higher Education; Information Technology; Matrices; Professional Associations; State Departments of Education; Teacher Certification; *Teacher Competencies; *Technological Literacy
IDENTIFIERS	Department of Defense; International Society for Technology in Education; Massachusetts Board of Education; Mississippi State Department of Education; North Carolina State Board of Education; Technology Utilization; Virginia Department of Education

ABSTRACT

Two recent trends in education--increased technology and accountability--are driving efforts to define technology competencies and standards for teachers. The first lists of competencies from these efforts are just now being completed. While some of these competencies are linked to teacher certification and re-certification, others are developed as standards or benchmarks to guide professional development. The purpose of this study was to examine and compare initial attempts at establishing teacher technology competencies with the intent of establishing a framework or matrix that could be used to compare other, similar documents. Teacher technology competencies from a variety of organizations and institutions were studied and compared. A master matrix of technology competencies was created, consisting of the following categories: (1) prerequisite technical skills--basic operations, hardware issues, navigation, and file management; (2) instructional uses--instructional strategies and resources; (3) professional roles--ethical/legal issues, professional resources, and professional development; and (4) technical skills--troubleshooting/maintenance, productivity tools, Internet applications, and networking. Based on findings, generalizations were drawn and recommendations made for improving future technology competencies. Also included is a discussion of the implications for teacher education programs and the need to use teacher technology competencies in an integrated effort which considers not only technology, but pedagogy and curricular content as well. (Contains 2 figures, 1 table, and 15 references.) (Author/AEF)

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Teacher Technology Competencies: Early Indicators and Benchmarks

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Abstract:

Two recent trends in education — increased technology and accountability — are driving recent efforts to define technology competencies and standards for teachers. The very first lists of competencies from these efforts are just now being completed. While some of these competencies are being linked to teacher certification and re-certification, others are developed as standards or benchmarks to guide professional development. The purpose of this study was to examine and compare initial attempts at establishing teacher technology competencies with the intent of establishing a framework or matrix that could be used to compare other, similar documents. Teacher technology competencies from a variety of organizations and institutions were studied and compared. A master matrix of technology competencies was created and based on our findings generalizations are drawn and recommendations are made for improving future technology competencies. Also included is a discussion of the implications for teacher education programs, and the need to use teacher technology competencies in an integrated effort which considers not only technology but pedagogy and curricular content as well.

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Acknowledgements

Special thanks to the North Central Regional Educational Laboratory and the Department of Defense Education Agency for financial assistance with this project.

Introduction

Over the last several years a variety of projects have attempted to define technology standards or competencies for K-12 students. In 1996, the National Study for School Evaluation (NSSE) released a 140 page document entitled "Technology: Indicators of Quality Information Technology Systems In K-12 Schools" that encouraged schools and districts to develop technology standards for their students and provided examples of what such standards might entail. More recently, the International Society for Technology in Education (in conjunction with 11 other professional organizations) developed a set of student standards entitled "Technology Foundation Standards for Students" (ISTEa 1998) as part if its National Educational Technology Standards Project (NETS) which described very specific technology standards for students. These performance indicators were broken into four grade bands and five domains (recently, those five domains have been expanded into six). In the summer of 1998, the American Library Association released standards for information literacy for all students (ALA 1998).

In order for students to be able to reach these standards, technology must not only be available, but must be utilized in the classroom. Students aren't the only ones who need to be prepared for the information age — teachers must also develop new skills and competencies in order to help their students meet the challenge of the next century. Espinosa and Chen discovered that in-service teachers recognized the need for computer literacy training. This need arose from the expectation that students must obtain computer literacy from schools. Teachers play a vital role in the student development; therefore, students cannot emerge from schools computer literate if teachers are not computer literate (Espinosa & Chen 1996). However, most currently practicing teachers are not products of the computer age, and despite best attempts, even new teachers coming out of the nation's universities and colleges are not as technologically prepared as they need to be. A recent article in *Electronic Learning* addressed the fact that many schools of education have a long way to go before they are able to adequately train teachers to use technology efficiently and effectively in their classroom instruction (Barksdale 1996).

While the increased use of technology is one trend in education today, accountability is another. Calls for increased accountability of teachers and schools – return on investment - are pressuring the educational community to

define curricular standards, create performance-based assessments, and develop new ways of evaluating teachers and students. In an effort to increase accountability several states have implemented accountability indicators. It is not surprising that professional organizations, state education agencies, and school districts around the country are now beginning to examine and define skills, performances, and competencies for their teachers in a variety of areas, including technology. The very first lists of competencies from these efforts are just now being completed. While some of these competencies are being linked to teacher certification and re-certification, others are developed as standards or benchmarks to guide professional development.

Purpose

The purpose of this study was to examine and compare these initial attempts at establishing teacher technology competencies with the intent of establishing a framework or matrix that could be used to compare other, similar documents. This study took place in the summer of 1998. True to the evolving nature of the teacher technology competency movement, at the time of this writing several other similar documents have been written or drafted which were unavailable to us at the time of the study.

Process

We began the process of comparison by identifying potential sources of teacher technology standards or competencies. Such documents are being developed by a variety of organizations, including professional educational organizations, non-profit education support organizations, educational reform organizations, state education agencies, and local school districts. The International Society for Technology in Education (ISTE) document "ISTE Recommended Foundations in Technology for All Teachers" is used by many organizations as the base from which competencies are established. In general, the farther removed an organization is from the classroom, the more general and broad its recommendations tend to be, allowing room for local organizations to define and develop standards most appropriate for that community. We wanted to identify a useful variety of documents to analyze, but recognized that the organizations needed to originate from roughly the same position in the educational system. Therefore, in addition to documents developed by ISTE (a professional organization), we also sought out documents developed by state education agencies and national organizations with interests in educational technology. Additionally, we limited our study to those competencies that were not specific to any particular curricular area or grade band. We certainly recognize that there may well be differences between what a high school science teacher and a 3 rd grade teacher may need to know in regards to technology. Despite this recognition, the scope of this study focused only on those technology competencies that apply to all teachers.

State agency documents were located through a web search of those states generally regarded as leaders in the use of technology. Calls were made to agencies whose web sites indicated that student competencies had been developed and/or whose technology plans recommended that teacher technology competencies or standards be developed. Many states are in the process of developing teacher technology competencies but few have yet to complete this process. Four states' competencies were selected for inclusion in this report. While several school districts have developed teacher technology standards, none were included in this report, as they tend to be very specific and locally oriented. Documents that addressed standards for students instead of teachers, did not address technology use as a major feature, or were organized in such a way that competencies resulting from the statements given would have to be largely inferred or assumed were not included in our analysis. The following documents were included in this study:

- ISTE Recommended Foundations in Technology for All Teachers (ISTEb 1998)
- North Carolina Technology Assessment Project (North Carolina School Board of Education (1995)
- NCRTEC Portfolio: Training and Professional Development – curricular strands (draft) (NCRTEC 1997)
- Professional Development Continuum (draft) Milken Family Foundation (Milken 1998)
- Technology Standards for Instructional Personnel Virginia (Virginia Department of Education 1998)
- Instructional Technology Standards Mississippi (Mississippi Department of Education 1995)
- ABE Teacher Competencies for Technology (draft) Massachusetts (Massachusetts Department of Education 1997)
- Professional development plan for teacher competency in technology (draft) DoDEA (Department of Defense Education Agency 1998).

Once the representative set of competency and standard documents were identified, they were photocopied on different colored paper, cut apart, grouped together by similarity, and assigned category names. After the competencies were organized and categorized, phrases representing competencies were written in an attempt to capture the variety of competencies and skills represented by the individual statements from the various organizations. In some cases, this meant combining several statements into one, in other cases we split large, complex statements into smaller,

more discreet units. A master list of competencies was drafted, placed into a matrix and reviewed. A close examination of the matrix revealed a few competencies that are not covered by any of the organizations examined. While it could be argued that many of the broad competencies infer these skills, the detail to which some of the competency lists are stated encouraged us to add skills where some were missing. We added these competencies after reviewing the entire list. Through our experience working with both in-service and pre-service teachers, these are skills or competencies that we feel are needed in addition to the others listed, and were thus incorporated into the master matrix. Since the ISTE standards (ISTEb 1998) are used by many organizations as a starting point for the development of their standards, we "tested" the list by comparing the ISTE standards to it to make sure they were all represented. Finally, competencies of the various organizations were entered into the matrix and a master matrix was developed which allowed comparisons between competency lists to be made.

Not surprisingly, it is difficult to develop statements that adequately reflect competencies and standards that were developed using a wide range of organizational structures, as well as for different purposes and audiences. At times, we had to infer the intent of some statements. Subsequently, replications of this process might yield somewhat different results. In spite of this, however, this comparison represents a first attempt at understanding the variety and breadth of teacher technology competencies in their infancy. As other competencies are developed, this matrix can be used to compare and contrast them to what currently exists, as well as identify weaknesses or holes in competency sets. As technology and our understanding of its power to transform what it means to teach and to learn change, this matrix can be updated and revised to reflect these new understandings.

Findings

Four major categories emerged from our analysis: Prerequisite Technical Skills, Technical Skills, Instructional Uses, and Professional Roles. Each of these categories contained groups of related competencies and was also subsequently given labels. All categories contained two or more subcategories, and one subcategory in the Technical Skills category was broken down into several sub-subcategories.

Prerequisite Technical Skills are skills that are so basic in nature (e.g. correctly turn on and shut down a computer) that they must be mastered before any other skills or instructional applications can be learned. Technical Skills are skills that are hardware/software based. These "how to" skills underlie all use of computer and related technologies.

Instructional Use competencies are those which focus on applications of technology in classroom instruction and student learning. The development of Technical Skills and Instructional Use competencies will most often happen concurrently. One competency set does not necessarily precede the other; rather teachers best learn them in conjunction. In fact, research shows that teachers react negatively to those courses that just emphasize technical skills without regard to teacher practice and teaching (OTA 1995) (p 137).

Complementing all competencies are those associated with teachers' Professional Roles. These competencies reflect those activities and behaviors which teachers must engage in an information age classroom. These behaviors and competencies are essential for all teachers regardless of their proficiency in using technology in the classroom. The competency categories and subcategories are listed below (Tab. 1):

Competency Categories	
Prerequisite Technical Skills	**Technical Skills**
Basic Operations	Basic Technical Skills
Hardware Issues	Advanced Technical Skills
Navigation	Troubleshooting and Maintenance
File Management	Adv. Troubleshooting & Maintenance
	Productivity Tools
	Word Processing
Instructional Uses	Database
Instructional Strategies	Spreadsheet
Instructional Resources	Graphics
	Multimedia
	Advanced Multimedia Advanced
Professional Roles	Productivity Tools
Ethical and Legal Issues	Internet Applications
Professional Resources	Adv. Internet Applications
Professional Development	Networking
	Advanced Networking

Table 1: Competency Categories and Subcategories

Several characteristics of this list of competency categories are immediately apparent. First, there are considerably more subcategories in the Technical Skills category than in the other three. We imagine that this reflects the tendency to focus on hardware and software skills rather than instructional integration skills. On the other hand the large number of subcategories illustrates both the array of technology opportunities available to teachers as well the breadth of competencies in technical skills that teachers must develop. Second, in some instances, organizations had broken some of the technical skills into basic and advanced. For example, Productivity Tools, Internet Applications, and Networking all had advanced competencies listed. Finally, only the Prerequisite Technical Skills category is entirely prerequisite to all others. The remaining can be learned in any order (or concurrently) depending on the specific instructional application and time available to learn the hardware, software, and instructional or professional application.

The diagram below (Fig. 1) illustrates our initial view of the interrelationships between these competency categories. Notice that the Prerequisite Technical Skills category underlies and is prerequisites to all other competency categories. Each of the other categories, Instructional Use, Technical Skills, and Professional Role categories can be developed independently and concurrently. Often times increased competency in one category leads to increased competency in others.

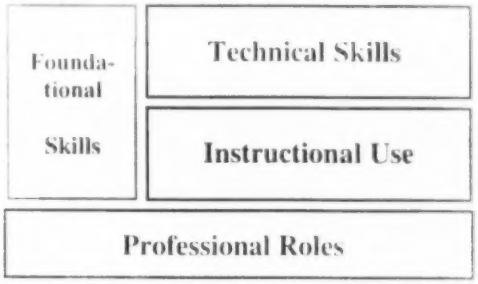

Figure 1: Major Categories of Teacher Technology Competencies

In general, teacher technology competencies appear to cover a wide range of skills and instructional applications. A review of the predominant institutions developing competencies revealed the following biases:

- ISTE, Virginia, and Mississippi covered the general scope of competencies with broad sweeping statements. Although the competency areas were addressed, the detail necessary to add value was lacking, leaving many questions unanswered.
- North Carolina competencies emphasized evaluation of skills (not surprising considering this document is guiding evaluation and certification of teachers). Therefore, their document was extremely detailed in the technical skill competencies.
- Massachusetts appears to be very technical skill based; however, the section covering multimedia skills seems fairly weak. Massachusetts's competencies failed to address both instructional and professional skill areas.
- Only one document (Milken) organized its competencies around stages of teacher change, listing different performances or behaviors that teachers would engage in at different points in their own development. While this orientation provided challenges to finding fit with other competencies, we found it to be very well thought out and potentially the most useful for identifying professional development needs. Two other documents (North Carolina and Massachusetts) included advanced levels of skill and performance but were not tied to teacher development or change theory.

Implications

We believe that it is a strength to allow schools to define, based on the learning needs of their students, what each of these competencies mean. That is, depending on the curricular goals that they are trying to achieve through technology, schools will identify particular applications and the necessary skills that teachers must possess in order to use those applications. It must be stressed that the purpose of these competencies is to ensure that all teachers can use technology appropriately to support learning; achieving the competencies is a means to an end and not an end in itself. The more specific competencies presented in the master matrix might be used by schools to guide the development of workshops and support materials to ensure that all teachers have the opportunity to develop particular skills that are most appropriate.

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We strongly encourage schools to focus on the vision of learning that they are developing these competencies to support. Professional development activities that teach technical skills should always do so in the context of designing a lesson, creating curricula, or solving an instructional problem.

In addition, assessment of teacher competence with technology should be authentic and i ndicate whether the competencies teachers possess are adequate to support the vision of learning in actual classroom settings. We recommend that schools closely examine documents that provide deeper guidance about improving curriculum, instruction, and assessment with technology. *Plugging In*, by NCREL (Jones et. al. 1995), and the Milken Technology Professional Development Continuum (Milken 1998) both present indicators of technology supported engaged learning that can be used to expand a vision of learning and guide the appropriate integration of technology.

The establishment of technology competencies for teachers have has special implications for teacher education programs. As stated earlier, requiring students to have technology competencies will also require teachers to have technology competencies. Over the course of the last decade technology has been gaining more importance in teacher education programs but most programs still have a way to go before they can adequately prepare their graduates to use technology to its fullest potential in their teaching and administrative activities (Barksdale 1996).

Many teacher education programs have begun to offer classes that instruct students on techniques for using technology. However, in order to fully prepare teachers to teach with technology, teacher education program staff must demonstrate proper use of technology for teaching in their own instruction. It would seem that the need for technology competencies has worked its way from the bottom up. The need for technology competencies for students has inspired the need for technology competencies for teachers, and we feel that this in turn should indicate the need for technology competencies among those staff members who are training students to become teachers.

A final consideration is to make sure that technology is used to help students meet content standards. Technology skills for students are important but the thrust must be on learning and understanding content. Thus an emphasis must be placed on using technology to help students achieve the most difficult to learn, yet critical concepts. To do so teachers must possess an adequate grasp of the content. While the technology staff development curriculum can and should address competencies in both technology and pedagogy, the basis for increasing competence in the content areas must come from content-specific curriculum staff development activities. It is crucial, therefore, to integrate technology, pedagogy, and content staff development activities into a single, coherent effort (Fig. 2).

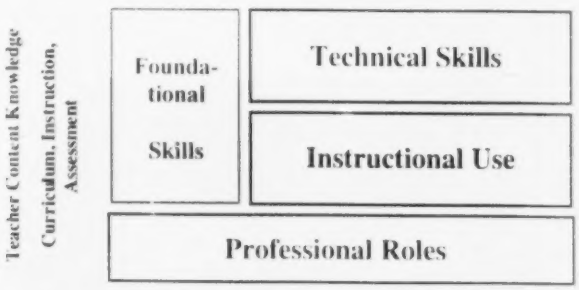

Figure 2: Interrelationships of Teacher Content Knowledge, Pedagogy, & Teacher Technology Competencies

The fundamental competency areas needed to be possessed by teachers if they are to use technology to engage students and to help them learn meaningful content is shown in the diagram above. Notice that there are three foundational competency domains that teachers must possess: Pedagogy (curriculum, assessment, and instruction), Prerequisite Technical, and Content Knowledge. From these domains teachers refine and develop skills and knowledge in the application of technology to support learning in content areas. The development of technology competencies should always be viewed in the context of this interrelated system of knowledge, skills, and experience.

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